

**WHAT IS CLAIMED IS:**

1. A composition comprising one or more particulate plant sterols, wherein said composition demonstrates a multi-peak volume-weighted or mass-weighted particle size distribution (PSD) of said one or more particulate plant sterols;  
wherein said composition demonstrates a multi-peak surface-area-weighted PSD of said one or more particulate plant sterols; and  
wherein said composition, when dispersed in a test juice, has an acceptable mouthfeel in said test juice.
2. The composition of claim 1, wherein said multi-peak volume- or mass-weighted PSD demonstrates:
  - a) a first peak of particulate plant sterols having a diameter less than 2 microns and a volume-weighted mean particle diameter of about 0.3 to about 0.5 microns; and
  - b) a second peak of particulate plant sterols having a diameter in the range from 2 to about 35 microns, wherein said second peak has a volume-weighted mean particle diameter of about 8 to about 12 microns.
3. The composition of claim 2, wherein said second peak represents from about 65% to about 85% of said volume- or mass-weighted PSD, and wherein said first peak represents from about 15% to about 35% of said volume- or mass-weighted PSD.
4. The composition of claim 1, wherein said composition demonstrates a multi-peak surface area-weighted PSD of said one or more particulate plant sterols.
5. The composition of claim 4, wherein said surface-area weighted PSD demonstrates:
  - a) a first peak of particulate plant sterols having a diameter less than 2 microns; and
  - b) a second peak of particulate plant sterols having a diameter in the range from 2 to about 35 microns, and wherein said second peak has a surface-area-weighted mean particle diameter of about 8 to 12 microns.

6. The composition of claim 5, wherein said first peak of particulate plant sterols represents from about 78% to about 92% of said surface-area weighted PSD.

7. The composition of claim 5, wherein said first peak of particulate plant sterols having a diameter less than 2 microns has a surface-area weighted mean particle diameter of about 0.5 microns or less.

8. The composition of claim 7, wherein said first peak of particulate plant sterols having a diameter less than 2 microns has a surface-area weighted mean particle diameter of from about 0.3 microns to about 0.5 microns.

9. The composition of claim 8, said first peak of particulate plant sterols having a diameter less than 2 microns has a surface-area weighted mean particle diameter of about 0.4 microns.

10. The composition of claim 4, wherein the total specific surface area of said multi-peak surface area-weighted PSD is greater than about  $2 \text{ m}^2/\text{g}$ .

11. The composition of claim 10, wherein the total specific surface area of said multi-peak surface area-weighted PSD ranges from about 2.5 to about  $7 \text{ m}^2/\text{g}$ .

12. The composition of claim 11, wherein the total specific surface area of said multi-peak surface area-weighted PSD ranges from about 2.8 to about  $6.5 \text{ m}^2/\text{g}$ .

13. The composition of claim 3, wherein the volume-percentage of all particulate plant sterols having a diameter greater than 35 microns in said volume- or mass-weighted PSD is less than about 3%.

14. The composition of claim 13, wherein the volume-percentage of all particulate plant sterols having a diameter greater than 35 microns in said volume- or mass-weighted PSD is less than about 0.5%.

15. The composition of claim 1, wherein said composition is dispersible in an aqueous medium.

16. The composition of claim 1, wherein said composition is an aqueous composition.

17. The composition of claim 1, wherein said composition is a powdered composition.

18. The composition of claim 1, wherein said composition is a food or beverage composition.

19. The composition of claim 18, wherein said beverage composition is selected from the group consisting of a juice, a juice concentrate, coffee, tea, a smoothie, a shake, soy milk, rice milk, a frappe, a milk fluid, a meal replacement beverage, a diet beverage, and a nutritional supplement beverage.

20. The composition of claim 18, wherein said food composition is selected from the group consisting of a bread, a baked good, candy, ice cream, a confection, an egg, an egg replacement, ice cream, yogurt, a health supplement, a meal replacement food, and a nutritional supplement.

21. A process for preparing a particulate plant sterol composition comprising:  
a) cooling a plant sterol starting material; and  
b) subjecting said cooled plant sterol starting material to impact or attrition milling.

22. The process of claim 21, wherein said plant sterol starting material consists essentially of 1 or more plant sterols.

23. The process of claim 21, wherein said plant sterol starting material does not include an emulsifier.

24. The process of claim 21, wherein about 88% to about 100% by weight of said plant sterol starting material is 1 or more plant sterols.

25. The process of claim 24, wherein said plant sterol starting material includes vitamin E and/or tocopherol.

26. The process of claim 21, wherein said plant sterol starting material is cooled in the range from about -100 °F to about -275 °F.

27. The process of claim 26, wherein said plant sterol starting material is cooled in the range from about -175 to about -250 °F.

28. The process of claim 27, wherein said plant sterol starting material is cooled to about -225 °F.

29. The process of claim 21, wherein said plant sterol starting material is cooled with liquid nitrogen.

30. The process of claim 21, wherein said impact or attrition milling is performed with a gap mill.

31. The process of claim 30, wherein said gap mill has a rotor-stator gap in the range of from about 0.025" to about 0.05".

32. The process of claim 31, wherein said rotor-stator gap is about 0.03".

33. The process of claim 30, wherein said impact or attrition milling with said gap mill is performed in a single pass.

34. The process of claim 30, wherein said gap mill has an average tip speed of from about 110 m/s to about 150 m/s.

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124 35. The process of claim 34, wherein said average tip speed is from about 120 to about  
125 135 m/s.

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127 36. The process of claim 30, wherein said particulate plant sterol composition is  
128 discharged from said gap mill at a temperature from about -25 to about -275 °F.

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130 37. The process of claim 36, wherein said particulate plant sterol composition is  
131 discharged from said gap mill at a temperature from about -40 to about -75 °F.

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133 38. The process of claim 37, wherein particulate plant sterol composition is discharged  
134 from said gap mill at a temperature from about -40 to about -50 °F.

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136 39. The process of claim 21, wherein said plant sterol starting material is in the form of  
137 pastilles having a diameter of from about 1 mm to about 4 mm.

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139 40. The process of claim 39, wherein said pastilles have a diameter of about 2 mm.

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141 41. The process of claim 21, wherein said cooled plant sterol starting material is  
142 subjected to impact or attrition milling in the presence of one or more of the following: a  
143 flow agent, a colorant, a flavorant, a vitamin, a mineral, a source of fiber, a protein, and a  
144 nutritional additive.

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146 42. The process of claim 41, wherein said flow agent is sodium aluminosilicate.

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148 43. The process of claim 41, wherein said colorant is  $\beta$ -carotene.

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150 44. The process of claim 41, wherein said mineral is calcium.

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152 45. A process for preparing a particulate plant sterol composition comprising:

a) milling a plant sterol starting material in a vortex mill having an inlet air pressure of from about 5 to about 6 bar and an outlet temperature of less than about 100 °F.

46. The process of claim 45, wherein said milling is performed at a temperature from about 60 to about 80 °F.

47. The process of claim 45, wherein said milling in said vortex mill is performed in a single pass.

48. The process of claim 45, wherein said plant sterol starting material consists essentially of 1 or more plant sterols.

49. The process of claim 45, wherein said plant sterol starting material does not include an emulsifier.

50. The process of claim 45, wherein about 88%-100% by weight of said plant sterol starting material is 1 or more plant sterols.

51. The process of claim 50, wherein said plant sterol starting material includes vitamin E and/or tocopherol.

52. The process of claim 45, wherein said plant sterol starting material is milled in the presence of one or more of the following: a flow agent, a colorant, a flavorant, a vitamin, a mineral, a source of fiber, a protein, and a nutritional additive.

53. The process of claim 52, wherein said flow agent is sodium aluminosilicate.

54. The process of claim 52, wherein said colorant is  $\beta$ -carotene.

55. The process of claim 52, wherein said mineral is calcium.

56. The process of claim 45, wherein said plant sterol starting material is in the form of pastilles having a diameter of from about 1 mm to about 4 mm.

57. The process of claim 56, wherein said pastilles have a diameter of about 2 mm.

58. A particulate plant sterol composition prepared by the process of claim 21.

59. A particulate plant sterol composition prepared by the process of claim 45.

60. A method for preparing an aqueous dispersion of a particulate plant sterol composition, comprising mixing a particulate plant sterol composition with an aqueous material, wherein said particulate plant sterol composition demonstrates a multi-peak surface area-weighted PSD.

61. The method of claim 60, wherein said multi-peak surface-area weighted PSD demonstrates:

- a) a first peak of particulate plant sterols having a diameter less than 2 microns; and
- b) a second peak of particulate plant sterols having a diameter of 2 to about 35 microns, wherein said second peak has a surface-area weighted mean particle diameter in the range from about 8 to about 12 microns.

62. The method of claim 61, wherein said first peak of particulate plant sterols represents from about 78% to about 92% of said surface-area weighted PSD.

63. The method of claim 61, wherein said first peak of particulate plant sterols having a diameter less than 2 microns has a surface-area weighted mean particle diameter of about 0.5 microns.

64. The method of claim 61, wherein said first peak of particulate plant sterols having a diameter less than 2 microns has a surface-area weighted mean particle diameter of from about 0.3 microns to about 0.5 microns.

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216 65. The method of claim 64, wherein said first peak of particulate plant sterols having a  
217 diameter less than 2 microns has a surface-area weighted mean particle diameter of about 0.4  
218 microns.

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220 66. The method of claim 61, wherein the total specific surface area of said multi-peak  
221 surface area-weighted PSD is greater than about 2 m<sup>2</sup>/g.

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223 67. The method of claim 66, wherein the total specific surface area of said multi-peak  
224 surface area-weighted PSD ranges from about 2.5 to about 7 m<sup>2</sup>/g.

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226 68. The method of claim 67, wherein the total specific surface area of said multi-peak  
227 surface area-weighted PSD ranges from about 2.8 to about 6.5 m<sup>2</sup>/g.

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229 69. The method of claim 61, wherein said aqueous material is selected from water, juice,  
230 a juice concentrate, coffee, tea, an egg mixture, ice cream, yogurt, soy milk, and a milk-based  
231 fluid.

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233 70. A composition comprising a dispersion of a particulate plant sterol composition in an  
234 aqueous material, wherein said particulate plant sterol composition demonstrates a multi-  
235 peak surface area-weighted PSD, and wherein said multi-peak surface-area weighted PSD  
236 demonstrates:

237 a) a first peak of particulate plant sterols having a diameter less than 2 microns; and  
238 b) a second peak of particulate plant sterols having a diameter of 2 to about 35  
239 microns, wherein said second peak has a surface-area weighted mean particle diameter of  
240 about 8 to about 12 microns.

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242 71. The composition of claim 70, wherein said composition has no or only a slight  
243 detectable chalky mouthfeel.



72. The method of claim 60, wherein said particulate plant sterol composition is mixed with said aqueous material in order to substantially avoid an undesirable sensory attribute in said aqueous dispersion.

73. The method of claim 72, wherein said undesirable sensory attribute is a chalky, gritty, drying, or powdery mouthfeel.

74. A method for preparing a dispersion of a particulate plant sterol composition, comprising homogenizing a particulate plant sterol composition with a pulp.

75. The method of claim 74, wherein said homogenizing step further includes water.

76. The method of claim 75, wherein prior to said homogenizing, said pulp, said water, and said particulate plant sterol composition are mixed with high shear.

77. The method of claim 74, wherein said homogenizing step is performed in two stages.

78. The method of claim 77, wherein said first homogenizing stage is performed at a higher psi than said second homogenizing stage.

79. The method of claim 74, wherein said pulp is a citrus pulp selected from orange pulp, lemon pulp, lime pulp, and grapefruit pulp.

80. The method of claim 75, wherein said water:pulp ratio by weight is about 1:1 to about 4:1.

81. The method of claim 75, wherein said particulate plant sterol composition is about 1% to about 10% by weight of said total amount of said pulp, said water, and said particulate plant sterol composition.

275 82. A method for preparing an aqueous dispersion of a particulate plant sterol comprising  
276 mixing a homogenized mixture containing a pulp and a particulate plant sterol composition  
277 with an aqueous medium.

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279 83. The method of claim 82, wherein said aqueous medium is a juice or juice concentrate.

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